Response to Recommendations of the DoE Review Of the D-Zero Upgrade Project

January 13-15, 1998

We offer responses below to all the recommendations made by the Review Committee at its last meeting in January. An action item from that review was a response to the recommendations in the Management section (5) and these are included herein. While most of the recommendations have been accepted, in a few cases they have not been strictly followed. We have considered the advice of the committee carefully and tried to shape it to best fit our needs in building the experiment on schedule and on budget. We are grateful for the help from the committee.

2.1 Solenoid (WBS 3.1)

Recommendation

1. A matrix of Hall probes should be mounted in the space between the central calorimeter and the end caps to verify the calculated field map.

The DØ experiment has added new collaborators from NIKHEF (Netherlands) who are interested in providing hardware for monitoring the field in the central detector region and outside the solenoid. They have developed Hall probes for monitoring the field in the LHC/ATLAS experiment and they are presently engaged in miniaturizing their instrumentation for deployment at DØ. We expect up to 100 such probes to be mounted in the central tracking region, on the faces of the forward pre-shower detectors and between the solenoid cryostat and the central calorimeter cryostat. We also expect to locate a few NMR probes on the inner surface of the solenoid cryostat to measure the field with high precision.

It should be noted the integral of B.dl outside the coil through the central calorimeter and into the muon central toroids is about 10% of its value inside the solenoid. The projected position of muons due to bending by the field beyond the bend radius of the coil is smaller than the circle of confusion due to multiple scattering. Thus, the field beyond the coil radius need be known with much less precision than the central field (a 10% measurement will probably suffice).

2.2 Silicon Tracker (WBS 1.1.1) and Tracking Electronics (WBS 1.1.5)

Recommendations

1. The silicon group should take an aggressive position to insure that the silicon and HDI procurement schedules are met.

Ladder and wedge production for D0 is paced by the delivery of HDI flex circuits. At the time of the last review, we had a single vendor (Litchfield Precision) and expressed concern about the vendor's ability to deliver circuits on schedule with acceptable quality. This continues to be a concern as Litchfield Precision has struggled to provide good parts. We have gone through an extensive search for additional flex circuit vendors that can meet our requirements. Two alternate vendors have been identified: Dyconex (Zurich, Switzerland) and Max Levy Autograph (Philadelphia, Pa.). Both vendors are considerably more expensive than Litchfield Precision. Our plan is to split our new orders between two companies. If one company experiences delivery problems, we have the option of increasing our order to the other. Our latest order is split between Dyconex and Litchfield Precision. F disk orders will be split between Max Levy Autograph and Dyconex. We have also changed our cabling

design for the barrels to reduce the number of HDI types by a factor of two. This will considerably simplify the procurement, assembly and testing of the ladder assemblies.

Ladder production with the final HDIs started in June. We have gone through the full assembly process including HDI and ladder burn-in and testing. The ladders have good noise performance and low numbers of bad channels.

2. The project management should work closely with CDF and laboratory management to ensure that the production of double-sided wafers at Micron remains on schedule. The possibility of offering financial incentives to Micron should be investigated as should the possibility of adding extra production shifts at Micron for the Fermilab projects.

CDF and DØ paid a joint visit to Micron Semiconductor in February. Our objective was to produce a coherent and feasible schedule that satisfies the needs of both projects. This schedule promised 50 9-chip detectors and 20 wedge detectors per month. To meet these requirements, Micron agreed to add personnel and improve processing to enhance their production capability. They felt that extra shifts would be counter-productive due to the lack of trained managers. They have hired 3 of 7-11 promised new workers and have extended working hours to meet the Fermilab requirements. To date, Micron has delivered 154 out of 600 “9-chip” detectors and 36 out of 175 “F Wedge” detectors. This rate is lower than the promised schedule but is sufficient to ensure that ladder production will not be limited by detector availability through this calendar year. There will be another DØ/CDF visit to Micron at the end of September.

3. Work around scenarios should be developed to understand the options if further delays occur. The silicon group and D-Zero project management should work together to understand the physics consequences and impact on the schedule of any change.

The only items not discussed above that are still in some doubt are the double-sided 90-degree stereo detectors. Prototypes are due from Micron in late August. If they are delayed, they will be abandoned and replaced either by “back-to-back” single-sided detectors (with some increase in multiple scattering) or by the originally-planned single-sided detectors that are easier to fabricate and are used elsewhere in the detector.

2.3 Fiber Tracker (WBS 1.1.2)

Recommendations

1. The construction of a prototype cylinder with all the ribbons mounted should be a Level 2 milestone.

We have added the milestone “First Cylinder Complete” dated January 27, 1999.

2. The completion of the full engineering design, which must include the assembly, alignment, and production schedule, should be a Level 2 milestone.

We have added the milestone “Assembly Design Complete” dated October 27, 1998.

3. A mechanism to monitor the detector position during operation needs to be included in the design.

Such facility, given the performance requirements and the tracker design, is neither necessary nor feasible. Trigger requirements dictate that the fibers of the tracker be aligned to 40 microns, and we are designing a system that will accomplish that precision with stability. Similarly, the silicon tracker components are aligned internally to better than 10 microns. The relative alignment of the silicon and fibers need be no better than fiber cylinder relative alignment. These stringent alignment specifications will be accomplished with CMM machines. There is no way to directly measure the positions of the tracker components in situ to this accuracy. Studies at SiDet and Lab 3 will demonstrate that the system is capable of performing as designed. High p_t tracks will be used *in situ* during the Collider run to verify detector alignment.

4. A full-time tracker (WBS Level 1.1) project manager should be appointed.

Phil Gutierrez (Oklahoma) has been appointed the WBS Level 2 Tracking System manager. As such, he will identify and address questions of integration and operation of the tracking system as a whole.

2.4 Preshower Detectors (WBS 1.1.3 & 1.1.4)

Recommendation

1. In order to test the final readout system, resources should be made available for an additional beam test when the new version of the SIFTS is ready later this year.

The SIFT chip is currently under test at Fermilab. Plans are underway for an extensive and realistic system test of a good fraction of the full tracking readout system using a random pulser to generate events. We are making a considerable effort to do this important testing without an accelerator because the effort to mount such a test is prohibitively large and would take key people away from critical work that cannot be delayed. Fermilab accelerators are shutdown and the test could only be conducted at Brookhaven. It would be extremely difficult to bring a VLPC system into operation at a distance.

2.5 Calorimeter (WBS 1.2)

Recommendation

None.

2.6 Muon Detectors (WBS 1.3)

Recommendations

1. An effort needs to be made to accelerate the fabrication of the forward trigger detectors.

a. By May 15, 1998, the pixel fabrication schedule should be 10 percent complete. At this point the production rates will be known and the schedule to complete should be reevaluated. If the schedule still anticipates completion on or near 1/2000 an effort needs to be made to find additional resources to increase the rate of production.

b. By August 1998, the mechanical technicians available for assembly of octants needs to be reevaluated in terms of schedule to complete.

The forward muon upgrade is indeed on the critical path and we are focusing a great deal of attention and resources on this project to speed up completion of the design and beginning of production. We have established a weekly design meeting that is quite productive. Production of pixel counters and MDT detectors has begun in Russia. We plan to increase our staff of mechanical technicians to help with assembly of these detectors into planes at Lab F. We have occupied the Lab F facility, set up an MDT test station and are establishing assembly facilities.

2. By April 1, 1998, the mechanical engineering requirements at Fermilab need to be re-evaluated and additional personnel made available if necessary.

We have added a contract Mechanical Engineer and a designer to this effort.

3. Insure the presence of personnel required during assembly and installation.

We are working with the Particle Physics Division management to make sure we have the personnel we need.

2.7 Trigger (WBS 1.4)

Recommendations

1. Institutions must be located to design and build the SLC fanout and FIC boards.

Our Collaborators from DAPNIA/Saclay have taken responsibility for the design and construction of the FIC boards. They have added two electrical engineers to their group. The overall specifications were established at a workshop in April. Prototype boards are now in production. The SLC Fanout will be built at Nevis Laboratories, Columbia University.

2.8 Data Acquisition and Online Computing System (WBS 1.5)

Recommendations

1. The DAQ and Online System TDR should be completed as planned so that it can be reviewed by D-Zero management as soon as possible.

The Online TDR is now ~75% complete and is expected to be submitted in October of this year. Work is not being held up for lack of this document. A proposal for the Level 3/DAQ system has been reviewed and accepted. About 80% of the Level 3/DAQ TDR is complete and is due in October of this year.

2. Both the Computer System Manager position and the unfilled Level 3 WBS management positions for DAQ and event monitoring should be filled immediately to ensure that the work being done is coordinated and meets the needs of the Collaboration.

The Online System Engineer position remains unfilled. This continues to be a problem because work is being done by existing personnel part-time, with some help from the Computing Division. A full-time professional is required and we have not been successful in identifying a suitable person in the Computing Division. An effort is underway to secure an opening in the Computing Division for a Computer Professional 6 for this job.

Level 3 DAQ management positions: We need two people for Event Monitoring and DAQ Monitoring (<1FTE). These individuals need to be identified in the Collaboration. These vacancies pose no problem now but must be filled by January 1999. The spokesmen are aware of the situation and are seeking to identify candidates.

3. The group should make sure that the six physicist FTE's needed for software work are identified and begin work by the mid-1998, as planned.

We have identified 3-4 individuals and two members of the Rochester group have recently joined the Collaboration and will work in this area. We are making progress in filling these needs.

2.9 Installation and Commissioning

Recommendations

The committee reiterates the recommendations from the previous review:

1. The immediate appointment of an experienced full time physicist as installation coordinator. This person will work closely with the Project Manager to ensure the timely preparation of the detector for physics.

We have appointed Dan Owen (Michigan State) as Commissioning Coordinator to facilitate commissioning of individual detector systems, leading to cosmic ray commissioning of the full experiment. Owen will coordinate the development of trigger, online, data acquisition systems with detector systems to ensure smooth and efficient debugging and testing of each and every system. He has begun work with appropriate subsystems to identify their specific commissioning needs and to develop a coherent schedule for commissioning to ensure that the work proceeds smoothly with no unnecessary delays.

Coordination of the physical installation of the detectors will continue to be the responsibility of the Project Manager. The Installation Engineer, Herm Stredde, reports directly to the Project Manager in this regard. Marvin Johnson, Level 3 manager of the Tracking Electronics and head of the Fermilab/DØ Electrical Support Group, is responsible for the electrical/electronic infrastructure throughout the experiment (racks, cables, monitoring, allocation of space in the platform and Movable Counting House).

2. The installation activity should be broken out into a separate item in the WBS with its own resource loaded schedule and budget. It should be linked appropriately to the component construction schedules.

We will not break installation activities into a separate WBS section with its own schedule and budget. Installation of detectors and electronics are currently embedded in the project schedule and it would not be helpful to separate them since they are so intimately linked to the detector preparation. Each installation task is loaded with the manpower and funds needed to complete the job. The installation costs are minimal and are included in the cost sections for the detectors. We see no advantage to separating these minor items from the detector subprojects responsible for their design and fabrication. The equipment needed is specific to the given detector and has no impact on other detectors.

3. COST

Recommendation

None.

4. SCHEDULE AND FUNDING

4.1 Schedule

Recommendation

3. That D-Zero and laboratory management evaluate with high priority every option which could re-introduce schedule flexibility.

We have worked with laboratory management to augment the ranks of engineers, designers and technicians in critical areas to expedite the work. We have analyzed production schedules and developed specific plans to speed up each of the major production efforts, should the need arise.

4.2 Funding

Recommendation

None.

5. MANAGEMENT

Recommendations

1. That the role of the project management group should be expanded so that it provides a real interface with CDF, D-Zero, and the accelerator. The intent of this is to help optimize the utilization of facilities and resources, to provide a forum to solve mutual problems and help in defining the schedule for completion and operation of the detectors.

We agree whole-heartedly with the sense of the recommendation. After considerable thought and discussions with Lab management, we have concluded that the most effective way to accomplish these goals is to convene a separate working group of representatives from the two experiments and the accelerator (managers and experts). The Director has initiated an effort to organize such a group.

Management should re-examine its decision to have the project manager take responsibilities for tracking and integration. The successful completion of the detector on time requires full time people in each of these three critical positions.

We have taken steps, as mentioned above, to appoint tracking and commissioning coordinators.

2. Particular attention needs to be paid to required engineering support as identified in the subsystem discussions, and mechanisms need to be found to supply those needs. In this regard, utilization of expert help from outside collaborators should be explored.

We are pursuing the support we need aggressively and have made real progress. All of the engineers that we have requested from the Lab are now on board. We have an unfilled opening to replace a designer who left the Lab. In several cases, additional engineering support has been secured at collaborating institutions.

3. Additional effort should be placed on contingency planning and identifying alternatives to critical path items.

We have made a very large effort here and continue to monitor and assess the situation as it develops.

6. ENVIRONMENT, SAFETY AND HEALTH

Recommendation

None.